

WHAT IS CLAIMED IS:

Sub 2

1. A method of masking comprising the operations of:

maintaining a surface to be etched below the freezing temperature of a phase-change masking material;

ejecting in liquid form droplets of the phase change masking material in a predetermined pattern on the surface to be etched, the droplets changing from a liquid to a solid after contact with the surface to form a first mask;

etching the surface to remove material from around said first mask to create a first etched surface; and

removing the first mask from said first etched surface.

2. The method of claim 1 wherein the surface to be etched is maintained at approximately room temperature, and the phase change material is heated prior to the operation of ejecting in liquid form.

3. The method of claim 2 wherein the phase change material is an organic phase change material.

4. The method of claim 3 wherein the phase change material is a wax.

5. The method of claim 1 wherein the operation of ejecting further comprises:

generating acoustic waves in a reservoir of the phase change material to eject said droplets.

6. The method of claim 1 wherein the operation of ejecting further comprises:

utilizing a piezoelectric to generate waves in a reservoir of the phase change material to eject said droplets.

7. The method of claim 1 wherein the operation of ejecting further comprises:

using thermal effects in a reservoir of the phase change material to eject said droplets.

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8. The method of claim 1 further comprising the operations of:
depositing a second layer to be etched over the etched surface;
maintaining the second layer to be etched below the freezing temperature of a second phase-change masking material;
ejecting in liquid form a second plurality of droplets of the second phase change masking material in a second predetermined pattern on the second layer

to be etched, the second plurality of droplets changing from a liquid to a solid after contact with the second layer to form a second mask;

etching the second layer to remove material from around said second mask to create a second etched surface; and

removing the second mask from said second etched surface.

9. The method of claim 8 further comprising the operations of:

detecting an alignment mark on the first etched surface;

using the alignment mark to determine an orientation and position of the first etched surface;

using the determined orientation and position to control movement of a droplet source ejecting the second plurality of droplets to properly position the second predetermined pattern.

10. The method of claim 8 wherein the operation of detecting the alignment mark further comprises the operation of:

adjusting a camera to image the alignment mark.

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11. The method of claim 1 wherein the phase-change masking material is a Kemamide-based wax solution.

12. The method of claim 1 wherein the phase-change material is a liquid at temperatures above 60 degrees centigrade and a solid at room temperature.

13. The method of claim 1 wherein the etching is a dry etching process and wherein the phase-change material possesses a low vapor pressure.

14. The method of claim 13 further comprising the operations of:

placing the surface to be etched in a chamber;

pumping down the chamber to achieve a low pressure.

15. The method of claim 1 wherein the operation of removing the first mask from said etched surface uses an organic solvent.

16. The method of claim 1 further comprising the operation of:

detecting an amount of spreading after deposition of a droplet of the phase change masking material on the surface to be etched; and

adjusting the temperature of the substrate prior to deposition of a subsequent droplet.

17. The method of claim 16 wherein when the operation of detecting detects excessive spreading, the temperature of the substrate is lowered.

18. The method of claim 16 wherein when the operation of detecting detects insufficient wetting, the temperature of the substrate is raised.

5/11/15 1) 19. A method of patterning a thin film comprising the operations of:

- depositing a thin film;
- depositing droplets of a phase change masking material with a freezing point between 50 and 100 degrees centigrade in a predetermined pattern on the thin film;
- etching the thin film to remove portions not protected by the droplets of the phase change masking material; and
- removing the droplets of the phase change masking material from the thin film.

20. The method of claim 19 wherein the thin film is a sacrificial layer such that after the etching operation of the thin film, the operations further comprise:

- etching the substrate beneath the thin film; and
- removing the thin film after removing the droplets of the phase change masking material.

21. The method of claim 19 wherein the droplets are generated using acoustic waves generated by at least one piezo-electric transducer.

22. The method of claim 20 wherein the droplets are generated using an ink-jet system.

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23. A method of performing a masking process comprising the operations of:

depositing a coating of photosensitive material on a substrate to be patterned;

maintaining the coating of photosensitive material at a temperature below the freezing point of a phase-change material;

depositing droplets of phase-change material on the photosensitive material in a predetermined pattern;

exposing the photosensitive material not protected by the phase change material to ultraviolet light;

removing the phase change material; and,

removing the photosensitive material on the substrate not exposed to the ultraviolet light.

24. The method of claim 23 wherein the photosensitive material is a spin-on polymer.

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25. The method of claim 23 wherein the spin-on polymer is SU-8.

26. A method of masking comprising the operations of:

maintaining a temperature of a surface to be etched above the boiling point of a liquid carrier, said liquid carrier including a suspended masking material;

ejecting in liquid form droplets of a solution including the liquid carrier and suspended masking material in a predetermined pattern on the surface to be etched, the liquid carrier rapidly evaporating after contact with the surface leaving the masking material to form a first mask;

etching the surface to remove material from around said mask to create a first etched surface; and

removing the mask from said first etched surface.

27. The method of claim 26 wherein the surface to be etched is maintained at approximately room temperature, and the phase change material is cooled prior to the operation of ejecting in liquid form.

28. The method of claim 26 wherein the operation of ejecting further comprises:

generating acoustic waves in a reservoir of the phase change material to eject said droplets.

29. The method of claim 26 wherein the operation of ejecting further comprises:

utilizing a piezoelectric transducer to generate waves in a reservoir of the phase change material to eject said droplets.

30. The method of claim 26 wherein the operation of ejecting further comprises:

using thermal effects in a reservoir of the phase change material to eject said droplets.

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